

CALIBRATION STANDARD REQUIREMENT  
FOR A  
MICROWAVE SYNTHESIZED SWEEP OSCILLATOR  
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PROCUREMENT PACKAGE

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# CALIBRATION STANDARD REQUIREMENT FOR A MICROWAVE SYNTHESIZED SWEEP OSCILLATOR

## 1. SCOPE

1.1 Scope. This requirement defines the mechanical and electrical performance requirements for a Microwave Synthesized Sweep Oscillator hereinafter referred to as the oscillator. The oscillator shall have synthesized broadband frequency coverage of 10 MHz to 20 GHz and shall provide the combined performance of a synthesized and a broadband sweep oscillator. The oscillator provides General Purpose Interface Bus (GPIB) capabilities in accordance with IEEE-STD-488. The oscillator is intended for use by shipboard and shorebased Navy personnel in association with calibration equipment used to calibrate microwave power measurement instruments and spectrum analyzers.

## 2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military requirement, Test Equipment for use with Electrical and Electronic Equipment, General specification for," and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this requirement.

## 3. REQUIREMENTS

3.1 General. The oscillator shall conform to the Type II, Class 5, Style 1 requirements as specified in MIL-T-28800 for Navy shipboard and shorebased equipment as modified below.

3.1.1 Design and Construction. The oscillator design and construction shall meet the requirements of MIL-T-28800 for Type III equipment.

3.1.2 Power requirements. The oscillator shall operate from a source of 103.5V to 126.5V at 60Hz (5% single phase input power as specified in MIL-T-28800).

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line, defined by MIL-T-28777, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800 with a 6-foot minimum length cord.

3.1.3 Dimension and Weight. Maximum dimensions shall not exceed 19 inches (485mm) in width, 8 inches (205mm) in height, and 25 inches (635mm) in depth. The weight shall not exceed 80 pounds (37 Kg).

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the cognate activity.

submitted to the procuring activity at the time of submission of proposal. Approval shall apply only to the specific model proposed.

3.1.5 Handles. Pull handles/knob guards satisfy the handle requirements of MIL-T-28800.

3.2 Environmental Requirements. The oscillator shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The oscillator shall meet the conditions below:

	<u>Temperature(°C)</u>	<u>Relative Humidity(%)</u>
Operating	10 to 30	95
	30 to 40	75
Non-operating	-40 to 70	Not controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE02, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The oscillator shall have an 85% or greater probability of remaining within tolerances of all requirements at the end of a 12 month period.

3.4 Maintainability. The oscillator shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The oscillator shall provide the following capability as specified below. Unless otherwise indicated, all performance requirements shall be met following a 30-minute warm-up period, over the temperature range of +10°C to +40°C and with line voltage variation of +/-10%.

3.5.1 Frequency. The oscillator shall provide the following performance capabilities.

3.5.1.1 Continuous Wave (CW) Mode and Manual Sweep. The oscillator shall provide the following performance capabilities in CW mode and manual (digital) sweep.

3.5.1.1.1 Frequency Range. The oscillator RF output frequency range shall be 10 Mhz to 20 Ghz in CW mode and manual (digital) sweep.

3.5.1.1.1.2 Frequency Resolution. The oscillator RF frequency maximum resolution shall be (1 Hz in CW mode and manual (digital) sweep.

3.5.1.1.3 Accuracy and Internal Time Base. The oscillator RF output frequency accuracy shall be equal to the internal reference time base accuracy.

3.5.1.1.3.1 Time Base Aging Rate. The oscillator internal time base shall have an aging rate of  $< 1 \times 10^{-9}$  per day after a 30 day warm-up.

3.5.1.1.3.2 Switching Time. The oscillator RF output signal shall have a switching time of  $< 100$  ms to be within specified frequency resolution.

3.5.1.2 Continuous Sweep, Center Frequency/Sweep Width, and Start/Stop Frequency. The oscillator shall provide the following performance abilities : continuous sweep, center frequency/sweep width, and start/stop frequency modes.

3.5.1.2.1 Range. The oscillator RF output signal shall have a 10 MHz to 20 GHz sweep frequency range.

3.5.1.2.2 Resolution. The oscillator RF output signal frequency resolution in swept mode shall be the larger of 0.2% of sweep width or 1 Hz.

3.5.1.2.3 Sweep Frequency Accuracy. The oscillator RF output swept frequency accuracy shall not exceed (2% of the indicated sweep width (sweep time  $> 1$  ms)).

3.5.1.3 Frequency Markers. The oscillator shall have at least five frequency markers that are independently settable as specified in the following subparagraphs.

3.5.1.3.1 Range. The frequency marker settable frequency range shall be at least from 10 Mhz to 20 Ghz.

3.5.1.3.2 Resolution. The frequency marker resolution shall be the larger of 0.2% of sweep width or 1 Hz.

3.5.1.4 Readout Accuracy. The oscillator shall have a frequency and marker readout uncertainty of ( 2% of the indicated sweep width (sweep time  $> 1$  ms)).

3.5.2 Spectral Purity. The oscillator shall provide the following performance for spectral purity in CW mode and all swept modes unless otherwise stated.

3.5.2.1 Spurious Signals. The oscillator shall provide the following spectral purity performance at 0 dBm carrier level.

3.5.2.1.1 Harmonics (up to 20 Ghz). Spurious signals which are harmonics of the carrier frequency shall be at least 30 dB below the carrier.

3.5.2.1.2 Subharmonics (up to 20 Ghz). Spurious signals, which are subharmonics of the carrier frequency shall be at least 25 dB below the carrier.

3.5.2.1.3 Non-Harmonically Related Spurious Signals (CW and manual Sweep Mode Only). The oscillator spurious signals which are non-harmonically related to the carrier frequency shall be at least 50 dB below the carrier.

3.5.2.1.4 Single-Sideband Phase Noise. The oscillator single-sideband phase noise performance expressed in dBc per 1 Hz noise bandwidth (BW) shall be less than 75 dB at 10 GHz in CW mode, 10Khz offset.

3.5.3 Radio Frequency (RF) Output. The oscillator shall provide the following performance for RF output.

3.5.3.1 Maximum leveled power. The oscillator RF maximum leveled power output shall be at least the following from +10(C to +35(C:

<u>Carrier Frequency</u>	<u>Level</u>
0.01 to 2.3 GHz	+10.0 dBm
2.3 to 7.0 GHz	+12.0 dBm
7.0 to 13.5 GHz	+10.0 dBm
13.5 to 20.0 GHz	+ 9.0 dBm

3.5.3.2 Minimum settable power. The oscillator minimum settable RF power shall be ( -80 dBm.

3.5.3.3 Output Power Resolution. The oscillator output power resolution shall be at least 0.1 dB.

3.5.3.4 Output Power Uncertainty. The oscillator RF output power uncertainty shall not exceed ( 1.5 dB.

3.5.3.5 Leveled Flatness. The oscillator output power level flatness across the frequency range shall not exceed ( 1.3 dB.

3.5.3.6 RF Output Impedance. The oscillator shall have a nominal RF output impedance of 50 ohms.

3.5.3.7 RF Output Standing Wave Ratio (SWR). The oscillator RF output SWR shall be < 2.0:1.

3.5.4 External Leveling Using Crystal Detectors. The oscillator shall have a mode that allows the oscillator to be externally leveled by crystal detectors.

3.5.4.1 External Leveling Using Power Meter. The oscillator shall have a mode that allows external power meter leveling.

3.5.4.2 External Leveling Input Signal Range. The oscillator external leveling input signal range shall be at least 500 microvolts to 0.5 volts for external leveling.

3.5.4.3 External Leveling Input Impedance. The oscillator external leveling shall have a nominal input impedance of 100 Kohm or greater.

3.5.5 Amplitude Modulation (AM). The oscillator shall provide in AM mode the performance capabilities specified in the following subparagraphs for leveled output signals ( 8 dBm.

3.5.5.1 AM Depth. The oscillator AM depth shall be settable from 0% to 90%.

3.5.5.2 AM Bandwidth. The oscillator AM mode shall have a 3 dB bandwidth of > 100 kHz.

3.5.5.3 AM Input Impedance. The oscillator shall have a nominal AM input impedance of 600 ohms or greater.

3.5.6 Frequency Modulation (FM). The oscillator shall provide in FM mode the performance capabilities specified in the following subparagraphs.

3.5.6.1 FM Bandwidth. The oscillator FM mode shall have a 3 dB bandwidth of at least 50 kHz to 10 Mhz.

3.5.6.2 Peak Deviation. The oscillator FM peak deviation shall be settable from 0 to the following:

<u>Rate</u>	<u>Peak Deviation</u>
DC to 100 Hz	(10 MHz
100 Hz to 1 MHz	( 7 MHz
1 MHz to 2 MHz	( 5 MHz
2 MHz to 10 MHz	( 1 MHz

3.5.7 Sweep. The oscillator shall provide the following sweep functions and performance capabilities.

3.5.7.1 Sweep Functions. The oscillator shall sweep the RF frequencies upward from the selected start frequency to the selected stop frequency in start/sweep mode. The oscillator shall sweep the RF output frequency symmetrically upward (( selected sweep width) about the selected center frequency in center frequency/sweep width mode.

3.5.7.2 Sweep Time. The oscillator shall have selectable sweep times from 0.01 seconds to at least 100 seconds.

3.5.7.3 Sweep Output. The oscillator shall have a direct coupled sawtooth output concurrent with the swept RF output. The waveform shall be a nominal 0 V at the start of the sweep and a nominal +10 V at the end of the sweep regardless of sweep width or direction. The sweep output connector shall be a type BNC female on the front or rear panel.

3.5.7.4 Sweep Trigger Modes. The oscillator shall have provision for selectable sweep trigger mode and for single sweep mode. The sweep input trigger connector shall be a type BNC female, on the front or rear panel.

3.5.8 RF blanking. The oscillator shall provide for RF blanking. With the RF blanking enabled, the RF shall be automatically turned off during retrace and on after completion of retrace.

3.5.9 Connectors. The oscillator shall have the following connectors.

3.5.9.1 Modulation, leveling, and sweep Connectors. The oscillator shall have BNC type female connectors for modulation input, sweep trigger input, leveling input, and sweep output.

3.5.9.2 Radio Frequency (RF) Connector. The oscillator RF output shall use a precision type N female connector in accordance with MIL-C-39012C.

3.6 Operating Requirements. The oscillator shall provide the following capabilities.

3.6.1 Standby/Operate. A STANDBY/OPERATE and/or RF ON/OFF switch shall be provided.

3.6.2 Error Correction. During calibration, the oscillator shall provide the capability to accept and store corrections for all measurement deviations from nominal conditions. The oscillator shall meet all the specified performance specifications without requiring additional entry of an calibration factor or other correction data.

3.6.3 Self Test. The self test shall determine operational readiness and isolate faulty modules.

3.6.3.1 Display. If the self test fails, the display shall indicate the nature of the failure and provide directions for diagnostic action.

3.7 Digital Interface. The oscillator shall provide a digital interface as specified in MIL-T-28800 and IEEE-488 General Purpose Interface Bus (GPIB).

3.7.1 Remote Programming Requirements. All modes, functions, and inputs/outputs of the oscillator shall be remotely programmable over the IEEE-488 General Purpose Interface Bus (GPIB).

3.7.2 GPIB Capabilities. The following IEEE-488 capabilities shall be provided:

T6 or TE - Talker,  
L4 or LE4 - Listener,  
SR1 - Service request,

3.7.3 Status Register Access Requirements. Access to status register shall be available via the IEEE-488 bus to ascertain oscillator mode, range and other operational and error status.

3.7.4 Bus String Terminator Requirements. Terminators for a string of bus commands shall be a carriage return followed by line feed and EOI signal.

3.7.5 Bus Address Switch. Address must be selectable without removing any covers.

3.7.6 Bus Error Handling Requirements. Bus error reporting and recovery conventions shall be fully described in the Operation and Maintenance Manual.

3.7.7 Compatibility. The oscillator, when used as part of an automated system, shall be capable of automatically energizing and /or calibrating.

applicable test instruments and measurement systems that are IEEE-488 b configured. The oscillator shall be compatible with the Fluke 1722A a 1722A/AP Instrument Controllers.

3.8 Accessories. The following accessories shall be provided with each oscillator.

3.8.1 Power Cable. One power cable in accordance with MIL-T-28800, with minimum length of 6 feet.

3.9 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.9.1 Calibration Procedure. A calibration procedure in accordance with MIL-M-38793 shall be provided.